

## ***FOCUS ON VOCABULARY AND LANGUAGE***

### **Neural Communication**

The story begins with the system's basic *building block*, the **neuron**, or nerve cell. *Building blocks* are the basic or fundamental parts (e.g., bricks) that make up a structure (e.g., a house). The structure of our nervous system, or neural information system, is made up of **neurons** (its *building blocks*).

#### *A Neuron's Structure*

Researchers have tracked some [neurons] *trudging along* at a *sluggish* 2 miles per hour, and others *racing along* at 200 or more miles per hour. The speed of the neural impulse ranges from extremely slow (*trudging along* or *sluggish*) to very fast (*racing along*). Compared with the speed of electricity or sophisticated electronics systems, your neural impulses travel at a relatively slow pace. At their fastest, they are still 3 million times slower than electric current traveling (*zipping*) through a wire.

“Like *elegant ladies air-kissing so as not to muss their makeup*, **dendrites** and **axons** don't quite touch,” noted poet Diane Ackerman (2004). The analogy here is to sophisticated females (*elegant ladies*) whose lips don't quite touch when they greet (they are *air-kissing*) to avoid disturbing their facial cosmetics (*so as not to muss their makeup*). Much like the small space between one lady's lips and her friend's cheek, there is a tiny gap separating the axon of a sending neuron and the dendrite or cell body of a receiving neuron. This gap (spatial *junction*) is called the **synapse**.

#### *How Neurons Communicate*

Most of these signals are *excitatory*, somewhat like *pushing a neuron's gas pedal*. Others are *inhibitory*, more like *pushing its brake*. Myers is making a comparison between the effect of a neuron firing and the effect of speeding up a car by pushing on its gas pedal (*excitatory effect*) or slowing it down by applying its brake (*inhibitory effect*). He also likens *excitatory* signals to those who love social gatherings (*party animals*) and *inhibitory* signals to those who do not (*party poopers*); if those who want to have a party outvote those who don't, then the party (**action potential**) will happen (i.e., *the party's on*).

*How then do we distinguish a big hug from a gentle touch?* This question is concerned with how we become aware of the magnitude of a stimulus, from a soft stroke or pat (a *gentle touch*) to a strong embrace (a *big hug*). The answer is that the intensity of the stimulus is a function of the number and frequency of neurons firing. A strong stimulus (*big hug*) does not initiate (*trigger*) a more powerful or faster impulse than a weak stimulus (*gentle touch*); rather, it *triggers* more neurons to fire, and to fire more often.

. . . “*runner's high*” . . . This refers to the feeling of emotional well-being or euphoria (the *high*) following vigorous exercise such as running or jogging. It is the result of the release of **opiatelike** substances called **endorphins**. Myers notes that these **neurotransmitters** are part of the brain's natural pain-reducing and mood-elevating chemistry (*its own “feel-good” chemistry*).

## The Nervous System

### *The Peripheral Nervous System*

Like an *automatic pilot*, this system may be consciously *overridden*, but usually operates on its own (*autonomously*). The **autonomic nervous system** (ANS) automatically takes care of the operation of our internal organs much as a plane can be flown by its onboard computerized, mechanical system (*automatic pilot* or *autopilot*). While the ANS is usually self-directed and independent (*autonomous*), the system can be consciously taken over (*overridden*) in the same way that the real pilot can take over flying the plane.

### *The Central Nervous System*

Being human *takes a lot of nerve*. Myers is using humor to make a point here. The expression “*it takes a lot of nerve*” means to be very brave or courageous (another expression, “it takes a lot of guts,” means the same thing!). Thus, when Myers states that being human *takes a lot of nerve*, the literal meaning in this context is that humans are made up of many, many nerves (the humor is derived from the double meaning).

All these neurons *cluster* into *work groups* called *neural networks*, . . . Myers points out that neurons communicate (*network*) with nearby neurons (*close neighbors*) via a short rapid connection. This is accomplished by *clusters* of interconnected neurons (*work groups*). Neurons work with nearby neurons for much the same reason people live (*cluster*) in cities—it is easier for brief, quick interactions. Learning occurs as feedback builds and strengthens these neural connections (*neurons that fire together wire together*).

. . . *two-way highway* . . . The spinal cord is similar to a freeway (*highway*) but, instead of cars moving up and down, sensory and motor messages (*information*) travel between the **peripheral nervous system** and the brain. This *information* moves either up to the brain or down from the brain.

## The Endocrine System

The endocrine system and nervous system are therefore *close relatives*. These two systems share similarities, are intimately connected, and, like two members of the same family, have much in common (they are *close relatives*). The **hormones** of the **endocrine system** are chemically equivalent to neurotransmitters, but operate at a much slower speed. Messages in the **nervous system** move very rapidly (*they zip along as fast as e-mail*) compared with endocrine system messages, which move relatively slowly (*they trudge along like regular or “snail” mail*).

In charge of this whole *electrochemical orchestra* is the *master conductor* we call the brain. Myers is comparing the functioning of the neurotransmitters and hormones to a large group of musicians (an *electrochemical orchestra*) whose movements and actions are directed by their leader (*the master conductor*), the brain.

## The Brain

### *Close-Up: Tools of Discovery—Having Our Head Examined*

Some use *microelectrodes* to *snoop on* the messages of individual neurons. Some attach larger electrodes to the *scalp* to *eavesdrop* with an **EEG (electroencephalograph)** on the *chatter* of billions of neurons. With today's technological tools it is possible to unobtrusively monitor (*snoop on*) the messages of single nerve cells using extremely small wires (*microelectrodes*). By attaching larger electrodes to the skin covering the skull (*scalp*) and using the EEG, it is possible to covertly listen to (*eavesdrop on*) the back-and-forth communication (*chatter*) of billions of nerve cells.

Others use scans that *peer into* the thinking, feeling brain and give us a *Supermanlike* ability to see what's happening. Modern technological means of viewing the brain, such as the **PET (positron emission tomography) scan**, **MRI (magnetic resonance imaging)**, and **fMRI (functional MRI)**, provide us with a greater-than-normal (*Supermanlike*) ability to look inside (*peer into*) the cortex without destroying tissue. (Note: *Superman* is a comic-book, TV, and movie character with x-ray vision, which allows him to see through solid matter.) As Myers points out, we are living in a period of great achievement and rapid progress (*a golden age*) of brain science.

### *Older Brain Structures*

Here, you'll find a *peculiar* sort of cross-wiring, with most nerves to and from each side of the brain connecting to the body's opposite side. In the **brainstem**, most nerves from the left side of the body connect to the right side of the brain and those from the right connect to the left side of the brain (*the brainstem is a crossover point*). The strange (*peculiar*) crisscross of nerves from one side to the other that occurs in the brainstem (this *cross-wiring*) is one of the many marvels or astonishing findings (*surprises*) about the brain.

. . . they made a *magnificent mistake*. Olds and Milner accidentally discovered (*stumbled upon*) a brain area that provides a pleasurable reward and then went on to find other similar areas. Myers calls this a splendid and spectacular error (a *magnificent mistake*). When rats are allowed to stimulate these areas by pressing a bar or lever (*pedal*) they seem to prefer this to any other activity and will continue at a very rapid rate (*feverish pace*) until they are too tired to go on (*until they drop from exhaustion*).

### *The Cerebral Cortex*

If you opened a human skull, exposing the brain, you would see a *wrinkled* organ, shaped somewhat like the *meat of an oversized walnut*. The human brain has a convoluted (*wrinkled*) surface, and the **cerebral cortex** is divided into two halves or hemispheres, just like the two lobes of the edible portion (the *meat* or seed) inside the shell of a very large (*oversized*) walnut.

In a sense, we *do* have *eyes in the back of our head!* This refers to the visual cortex of the **occipital lobes**, which processes visual information and is located at the rear of the brain. Thus, seeing is not done with the eyes alone but also involves specialized areas at the back of the brain. We need these areas to experience vision so, in a way, we do have *eyes in the back of our head!*

Their [the association areas] silence has led to what Donald McBurney (1966, p. 44) has called "one of the hardiest weeds in the garden of psychology": Do we really use only 10 percent of our brain? Just as weeds in a garden are extremely difficult to eradicate despite efforts to get rid of them, the myth that we use only 10 percent of our brain persists. This incorrect notion may have arisen because early researchers were unsure about the functions of the **association areas**. However, more

recent research into the brain's association areas showed that, while these areas don't have specific functions, they are involved in many different operations such as interpreting, integrating, and acting on sensory information and linking it with stored memories. Remember, we use all of our brain, all the time. Damage to the association areas would result in very serious deficits.

With his frontal lobes *ruptured*, Gage's *moral compass* had disconnected from his behavior. Phineas Gage's frontal lobes were severely damaged (*ruptured*) when a tamping iron shot through his head. As a result, he lost many of his normal inhibitions, which caused him to veer away from his previous honest ways (he lost his *moral compass*).

*What you experience as one continuous stream of perception is actually only the visible tip of a much larger iceberg. Most information processing takes place beneath the surface of conscious awareness.* Myers is making an analogy here. Most of the important functions that allow you to see the world as a whole are not part of conscious experience. Instead, like most of the mass of an iceberg, they are below the surface and out of awareness.

### *Our Divided Brain*

Waking from surgery, one even joked that he had a "*splitting headache*" . . . People have had their **corpus callosum** severed or cut to control epileptic seizures, and are thus called *split-brain patients*. Despite such a major operation this patient managed to make fun of the situation by saying that he had a very bad headache (a "*splitting headache*"). Personality and intellectual functioning were not affected by this procedure, and you would not be able to detect anything unusual if you were having a casual conversation with a *split-brain patient*.

Simply looking at the two hemispheres, so *alike* to the *naked eye*, who would suppose they contribute uniquely to *the harmony of the whole*? Myers points out that research with split-brain people and normal people shows that we have unified brains with different parts that have specialized functions. Thus, if we observe the two hemispheres without optical aids (with the *naked eye*), they may seem to be the same (appear *alike*); however, their differential functioning combines to produce an integrated unit (*the harmony of the whole*).

## **Brain States and Consciousness**

### *Selective Attention*

Now, suddenly, *the spotlight shifts. Your feet feel encased, your nose stubbornly intrudes on the words before you.* **Selective attention** refers to our tendency to focus on only a small part of what it is possible for us to experience. If you do attend to more aspects of your experience (if *the spotlight shifts*), you will be surprised at the amount of stimulation you process without awareness, such as the feel of the shoes on your feet (*your feet feel encased*) and the fact that your nose actually blocks your line of vision (*your nose stubbornly intrudes on the page before you*).

. . . they failed to notice a young woman carrying an umbrella *stroll* across the screen midway through the tape. In this experiment, viewers had to watch a video of basketball players and signal when the ball was passed. Because of their intense selective attention, they generally failed to notice a female walking slowly (*strolling*) through the players. In a replication of this study, the clever, humorous investigators (*smart-aleck researchers*) had a colleague in a gorilla costume (a *gorilla-suited assistant*) walk through the twisting, turning participants (the *swirl of players*). Fifty percent of the viewers failed to notice the gorilla! This failure to see visible objects when attention is directed elsewhere is called **inattentive blindness**.

## *Sleep and Dreams*

Try *pulling an all-nighter*, or working an occasional *night shift*. You will feel *groggiest* in the middle of the night but may *get new energy* around the time you would normally wake up. If we decide to stay up all night (*pull an all-nighter*) or have to work during the night (the *night shift*), we feel most mentally confused and uncoordinated (*groggiest*) about halfway through the night. But we may feel more lively and vigorous (*get new energy*) close to the time we would normally wake up.

. . . “owls” . . . “larks” . . . Like birds that are nocturnal (*owls* are an example), many younger adults stay up late and are lively at nighttime (they are *evening-energized* “owls”). As we get older, we are more energetic in the morning, and our performance tends to decline as the day progresses—much like birds that wake and become active with the dawn of a new day (*larks* do this).

. . . Aserinsky watched the machine *go wild*, tracing *deep zigzags* on the graph paper. The discovery of **REM (rapid eye movement)** occurred accidentally. To see if an EEG (electroencephalograph) was working properly, Aserinsky placed the electrodes near his 8-year-old son’s eyes. Periodically during the night the machine responded vigorously (*went wild*), producing a pattern of high-frequency waves (*deep zigzags*) on the printout. These patterns were produced by rapid, spasmodic (*jerky*) eye movements and accompanied by very frantic brain activity and, when awakened during one of these periods, the boy said he was dreaming.

. . . saw-toothed . . . During REM sleep, when most **dreams** occur, your brain waves resemble fast, uneven Stage 1 waves (they are *saw-toothed*). However, unlike Stage 1 sleep, REM sleep is characterized by internal physiological arousal and, paradoxically, near-paralysis of muscles.

*When consciousness leaves the highway, the brain’s road crews repair potholes while traffic is light.* One theory of why we need sleep suggests that sleep helps restore and repair brain tissue. Just as highway road workers (*road crews*) repair cracks and holes (*potholes*) in the road during the night when there is less vehicular traffic (*when traffic is light*), the brain uses the time when we are not actively alert and awake (*when consciousness leaves the highway*) to fix and mend itself.

*When the going gets boring, the students start snoring.* Teenagers get much less sleep than they need and are often seriously sleep deprived (*they have a large sleep debt*). As a result, they are very likely to fall asleep during class, especially during routine lectures (*when the going gets boring, the students start snoring*). Sleep deprivation can result in difficulty studying, diminished productivity, a tendency to make mistakes, irritability, and fatigue. As sleep researcher Dement noted, “a large sleep debt makes you stupid.”

. . . “spring forward” to “daylight savings” time and “fall backward” to “standard” time. Many countries adopt “daylight savings” time. This means that in the spring people move their clocks ahead one hour (“spring forward”) and back one hour in the fall (“fall backward”). Consequently, people lose one hour of sleep in the spring, which results in more traffic accidents on the Monday following the Sunday time change; with the extra hour of sleep in the fall, traffic accidents decline on the Monday following the time change.

The most popular *quick fixes* for true insomnia—sleeping pills and alcohol—can make things worse because they reduce REM sleep. The most common fast remedies (*quick fixes*) for **insomnia** are sleeping pills and alcohol. Unfortunately, they can aggravate the problem by suppressing REM sleep.

As a traffic menace, “*snoozing is second only to boozing*,” said the American Sleep Disorders Association, and those with narcolepsy are especially at risk (Aldrich, 1989). Falling asleep (*snoozing*) while driving is almost as serious a problem as drinking (*boozing*) and driving. People with **narcolepsy** suffer from occasional periods of uncontrollable sleepiness often associated with emotional arousal, and are thus in danger, and dangerous, while driving.

*Few dreams are sweet.* Dreams during REM sleep are vivid, emotional, and often very strange (*bizarre*). Not many dreams are pleasant, desirable, and satisfying (*few dreams are sweet*), and about 80 percent have the common themes of failing in an attempt to do something; being attacked, pursued, or rejected; and experiencing misfortune.

. . . Freud proposed that dreams act as a safety valve, discharging feelings that cannot be expressed in public. The story line of the dream (its **manifest content**) is a disguised version of the real, but hidden, meaning of the dream (its **latent content**). According to Freud, by symbolically expressing our hidden desires and erotic wishes, dreams allow us to ventilate unconscious drives that might otherwise be harmful (*they act as a safety valve*). (A *safety valve* allows a system to dissipate built-up pressure and thus may prevent an explosion.)

*Freud's critics say it is time to wake up from Freud's dream theory, which is a scientific nightmare.* Myers is having some fun with a play on words here. The expression “it is time to wake up from something” means one should start paying attention to reality and facts, rather than fantasy, and to say something is “a nightmare” means that it is unruly, difficult, or even frightening. Most contemporary psychologists believe that REM sleep and dreams are important aspects of our life but that Freud's theory of dream interpretation is erroneous, unscientific, and misguided (a *nightmare*); thus, we should not place much reliance on its explanations (*it is time to wake up from it*).

Yet what is unknown still *dwarfs* what is known. This means that all that has been discovered so far is very, very small (*dwarfed*) compared with what yet remains to be discovered. We live in a time when the rate of discovery about the interaction of our biology, behavior, and mental processes is truly exciting and awe-inspiring (*breathhtaking*). Yet, we still want to know how the mind and consciousness emerges out of brain tissue (*how do we get mind out of meat?*). Myers notes that perhaps “a brain simple enough to be understood is too simple to produce a mind able to understand it.”